

---

# **Development, Implementation, and Analysis of an Environmental Simulation Information Reference Library and Archive (ESIRLA)**

**John Burgeson**

**Science and Technology Corporation  
101 Research Drive  
Hampton, Virginia 23666-1340**

**December 1997**

**APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED.**

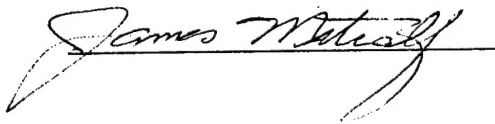


**AIR FORCE RESEARCH LABORATORY  
Space Vehicles Directorate  
29 Randolph Rd  
AIR FORCE MATERIEL COMMAND  
Hanscom AFB, MA 01731-3010**

---

**20020312 134**

This technical report has been reviewed and is approved for publication.

James M. Wooten

Robert D. Beland

This report has been reviewed by the ESC Public Affairs Office (PA) and is releasable to the National Technical Information Service (NTIS).

Qualified requestors may obtain additional copies from the Defense Technical Information Center (DTIC). All others should apply to the National Technical Information Center (NTIS).

If your address has changed, if you wish to be removed from the mailing list, or if the addressee is no longer employed by your organization, please notify AFRL/VSIM, 29 Randolph Road, Hanscom AFB, MA 01731-3010. This will assist us in maintaining a current mailing list.

Do not return copies of this report unless contractual obligations or notices on a specific document require that it be returned.

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE 31 Dec 1997	3. REPORT TYPE AND DATES COVERED Final, 15 Nov 1994-14 Nov 1997	
4. TITLE AND SUBTITLE Development, Implementation, and Analysis of an Environmental Simulation Information Reference Library and Archive (ESIRLA)			5. FUNDING NUMBERS C: F19628-95-C-0005 JON: DMSOGSBA	
6. AUTHOR(S) John Burgeson				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Science and Technology Corp. 101 Research Drive Hampton VA 23666-1340			8. PERFORMING ORGANIZATION REPORT NUMBER STC Tech Rept 3162	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Research Laboratory/VSBE 29 Randolph Rd. Hanscom AFB MA 01731-3010			10. SPONSORING/MONITORING AGENCY REPORT NUMBER  AFRL-VS-TR-2001-1667	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION AVAILABILITY STATEMENT Approved for public release: distribution unlimited			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words)  As part of the Environmental Effects for Distributed Interactive Simulations (E <sup>2</sup> DIS) Project, Science and Technology Corp. (STC) conducted a survey of the DoD environmental science community to identify cloud modeling and other environmental capabilities that support or could potentially support military modeling and simulation (M&S) efforts. STC also surveyed the DoD M&S community to determine its requirements for environmental data and models of environmental effects. The resulting data were stored in a PC-based relational database. STC organized and conducted two tri-service Cloud Impacts on DoD Operations and Systems (CIDOS) conferences to facilitate the exchange of information on cloud modeling techniques and applications for the benefit of the DoD environmental science community. STC determined the detailed requirements for weather effects products and decision aids for specific Air Force operational electro-optical systems.				
14. SUBJECT TERMS Environmental simulation, cloud modeling, E2DIS, CIDOS			15. NUMBER OF PAGES 8	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT Unlimited	

## FOREWORD

Science and Technology Corporation (STC) is pleased to submit this final summary report entitled "Development, Implementation, and Analysis of an Environmental Simulation Information Reference Library and Archive (ESIRLA)" by John Burgeson under Contract No. F19628-95-C-0005 of the same name. The period of performance was 15 November 1994 through 14 November 1997.

STC wishes to acknowledge the support and valuable assistance of the many individuals who were involved in the work performed under this contract. Several are named in the formal reports published during the contract period of performance. In particular, the consistent technical and administrative support of Mr. Donald Grantham, COTR for this contract, is hereby gratefully acknowledged.

## CONTENTS

	Page
FOREWORD.....	ii
1. FUNDED TASKS .....	1
1.1 E <sup>2</sup> DIS Project .....	1
1.2 CIDOS Tri-Service Conferences.....	2
1.3 Weather Effects Products for EO Systems.....	3
1.4 Outreach Program for PL/GP .....	4
1.5 THUNDER and EADSIM .....	4
1.6 Cloud Information Reference Library Archive.....	4
1.7 Weather Effects on EO Sensors for Conventional Weapons .....	4
2. REPORTS AND DATABASES .....	5

## 1. FUNDED TASKS

Science and Technology Corporation (STC) has completed all the tasks funded under Contract No. F19628-95-C-0005. Quarterly status reports have been submitted in accordance with contract requirements. The following paragraphs summarize the work completed during the course of the contract.

### 1.1 E<sup>2</sup>DIS Project

As part of the Environmental Effects for Distributed Interactive Simulations (E<sup>2</sup>DIS) Project, STC conducted a systematic survey of the DoD environmental science community to determine cloud modeling and other environmental capabilities that support, or could potentially support, military modeling and simulation (M&S) efforts. STC also completed a survey of the DoD M&S community to determine its requirements for environmental data and environmental effects models. For both surveys, a PC-based relational database was developed with commercial software to store and manage the surveyed information. STC personnel separately analyzed the results of the two surveys and documented the analyses in formal reports. The reports and databases were delivered to PL/GPAA.

#### Capabilities Survey

In accomplishing this survey, STC's Survey Team

- (i) Performed the background research needed to design, develop, and implement a comprehensive environmental capabilities questionnaire to survey the DoD environmental modeling and database community;
- (ii) Conducted the survey and analyzed its results to determine the capabilities of the environmental modeling and database community.
- (iii) Incorporated the results of this analysis into two draft reports: the *Environmental Model and Database Catalog*, and the *Analysis and Required New Capabilities Document*. The former document described and compiled a listing of the environmental models and databases developed or used by the military services; the latter assessed those environmental models and databases by comparing them with the requirements of the M&S community.

### Requirements Survey

To accomplish this survey, the Survey Team

- (i) Ensured that all major environmental requirements for models and databases that specify the near-earth, atmosphere, and near-space had been identified.
- (ii) Carefully quality controlled the database with indepth follow-up interviews (in person, telephone, telefax, or E-mail) with all points-of-contact as designated on the returned questionnaires.
- (iii) Analyzed the survey's preliminary results to determine the environmental requirements of the DoD M&S community.
- (iv) Prepared a paper on the results of the E<sup>2</sup>DIS survey of the DoD M&S community's environmental requirements, and presented the paper at the 13<sup>th</sup> DIS Workshop.
- (v) Prepared and delivered for review a draft of the *Tri-Service Environmental Simulation Requirements Document*. The E<sup>2</sup>DIS Survey Team formally reviewed the draft document while the team's members attended the Workshop (September 1995).

### Survey Reports

The E<sup>2</sup>DIS Survey Team completed a final review of the three reports discussed above. Although these reports could have individually stood alone, they were published as a three-part set: *Natural Environmental Effects in Military Models and Simulations: Part I—A Survey of Requirements*; *Natural Environmental Effects in Military Models and Simulations: Part II—A Survey of Capabilities*; and *Natural Environmental Effects in Military Models and Simulations: Part III—An Analysis of Requirements Versus Capabilities*. STC documented the database management systems containing the information obtained from the E<sup>2</sup>DIS Requirements and Capabilities Survey Questionnaires, and delivered the documentation and both databases to PL/GPAA for distribution.

## **1.2 CIDOS Tri-Service Conferences**

STC planned, made all arrangements for, and held two tri-service Cloud Impacts on DoD Operations and Systems (CIDOS) conferences, CIDOS-95 and CIDOS-97. The conferences enhanced the exchange of information on the most current cloud modeling techniques and applications for the benefit of the DoD environmental science community.

- (i) The theme for CIDOS-95, held on 24–26 October 1995 at Hanscom AFB, was *Cloud Modeling and Data for Defense Activities*, which emphasized sufficient physical reality in simulating clouds. STC produced a 250-page preprint of conference presentations and provided a copy on site to each of the more than 125 attendees.
- (ii) The theme for CIDOS-97, held 22–25 September 1997 at the Naval War College in Newport, RI, was *Cloud Effects on War Gaming, Modeling and Simulations*. STC Produced a 276-page preprint of conference presentations and provided a copy on site to each of the more than 100 attendees.

### 1.3 Weather Effects Products for EO Systems

STC determined the detailed requirements for weather effects products and decision aids for specific Air Force operational electro-optical (EO) systems. A final report was prepared on an analysis of the identified weather effects requirements for EO systems, including conclusions and recommendations for follow-on actions. STC provided and documented the database of the information collected during the requirements identification process. This work included the following activities:

- (i) Developed data collection sheets, designed the database, and developed lists of EO systems and cognizant user / developer.
- (ii) Made more than 50 separate individual contacts throughout the survey period to collect EO weather requirements from system operators (pilots), weather support personnel, and planners/developers of various C<sup>4</sup>I systems. Identified weather effects requirements for EO systems and developed a database of the information collected during the requirements identification process. Provided a preliminary summary of the results to LtCol Alleca, who used them at the Theater Battle Management (TBM) meeting in November 1995.
- (iii) Completed a PC-based relational database management system (developed with commercial software) containing the information collected on weather effects requirements for EO systems. Analyzed the identified requirements, developed conclusions and recommendations for follow-on actions, and submitted for review a



draft report entitled *Survey of Requirements for Weather Impact Decision Aids for Electro-Optical Systems*.

- (iv) Published report PL-TR-2066, entitled *Survey of Requirements for Weather Impact Decision Aids for Electro-Optical Systems* by Carl H. Chesley, J. Burgeson, and P. Try, February 1996. The report contains an analysis of the identified requirements for weather effects products and decision aids for specific Air Force operational EO systems. Prepared a database description of the information collected during the requirements identification process.

#### **1.4 Outreach Program for PL/GP**

STC compiled information for and developed a draft concept of an outreach program for PL/GP activities associated with weather and cloud impact research and development underway at PL/GP. STC personnel prepared and delivered an example briefing of the capabilities there.

#### **1.5 THUNDER and EADSIM**

STC researched the literature provided by PL/GP-M to prepare an interim report, *The Use of "Weather" in THUNDER and EADSIM*, on how environmental effects are accounted for in these two models. THUNDER accounts for two weather factors only: ceiling and visibility. These are allowed to affect probabilities of target acquisition, discrimination and kill, depending on the type of aircraft/weapon system combination. Weather is user provided in the form of scripts that specify actual and forecast ceilings and visibility. EADSIM does not account for weather. After PL/GP-M reviewed the report, STC published PL-TR-2285, *Weather Effects in Selected Air Warfare Simulations*.

#### **1.6 Cloud Information Reference Library Archive**

STC designed, tested, and published the Cloud Information Reference Library Archive (CIRLA) on the World Wide Web. The abstracts from the CIDOS-95 conference preprint volume were used to prepare Web pages for access from the CIRLA Home Page.

#### **1.7 Weather Effects on EO Sensors for Conventional Weapons**

STC extended the research of the literature to weather effects on electro-optical (EO) sensors used on precision-guided munitions. In this area of research, STC

- (i) Reported on weather effects in conventional weapons allocation models, which recently have been combined into the Conventional Forces Assessment Model (CFAM).
- (ii) Prepared a plan to use CFAM to determine the military value of incorporating weather information from environmental data records simulated from two experimental satellite systems. The plan included simulating an EO "visibility" that accounts for the weather's effect on employing EO weapon systems.
- (iii) Delivered a draft report entitled *Simulating the Use of Environmental Data in an Air-to-Ground Campaign* on 7 November 1997.

## 2. REPORTS AND DATABASES

During the course of the contract, STC delivered formal reports, and databases as well as a number of draft reports and conference preprint volumes. The formal reports and the databases are listed.

PL-TR-96-2029, Natural Environmental Effects in Military Models and Simulations: *Part I—A Survey of Requirements*

PL-TR-96-2040, Natural Environmental Effects in Military Models and Simulations: *Part II—A Survey of Capabilities*

PL-TR-96-2039, Natural Environmental Effects in Military Models and Simulations: *Part III—An Analysis of Requirements Versus Capabilities*

PL-TR-96-2066, Survey of Requirements for Weather Impact Decision Aids for Electro-Optical Systems

PL-TR-97-285, Weather Effects in Selected Air Warfare Simulations

The E<sup>2</sup>DIS Project Capabilities Survey Database

The E<sup>2</sup>DIS Project Requirements Survey Database

Database of Surveyed Requirements for Weather Impact Decision Aids for Electro-Optical Systems